National Aeronautics and Space Administration

CANTO 2018 Annual Conference and Trade Exhibition
Panama City, Panama
23 July 2018

Science Services Status
2019 World Radiocommunication Conference

This presentation will discuss the status and importance of specific spectrum regulatory issues, related to the science services, to the Caribbean and NASA, and how critical it is for the Caribbean and the Americas to have positions for the 2019 World Radiocommunication Conference that aids our entire region. It covers the benefits offered by Earth exploration-satellites, meteorological satellites, scientific research and space operations in our daily lives, and how they help us predict, track, and provide advanced warning about potential disasters that can impact the security and economy in our region.

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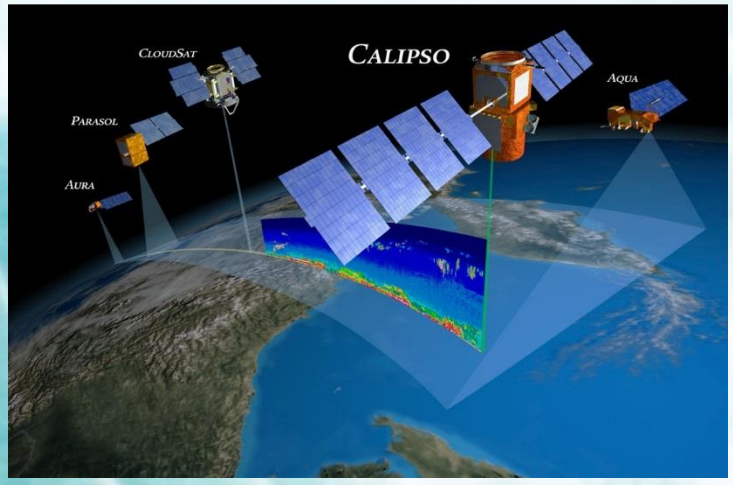
Spectrum for Science Missions Benefits Everyone

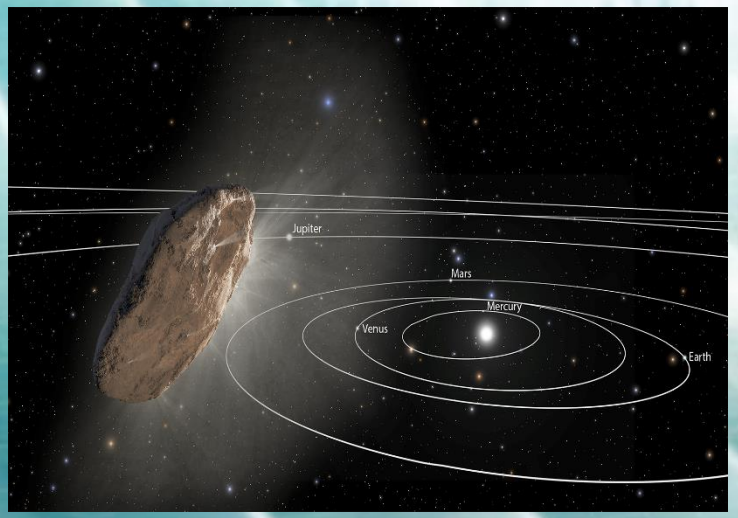
Science missions such as Earth-exploration and remote sensing that use frequencies allocated for Earth Exploration-Satellite Service (EESS) provide valuable information about, for example:

- Air quality monitoring
- Soil moisture mapping
- Sensing sea salinity
- Weather forecasting and climate models (winds, storms, clouds)



Another set of science missions use Space Research Service (SRS) allocations. These space research missions can support:

- On orbit research that for example can help in the creation of new drugs or the impact of the space environment on satellites
- Scientific information about the universe – stars, planetary science, solar system, and the future evolution of the universe



Spectrum for Science Missions Benefits Everyone

Science missions are critically important to Global Economies and Global Weather Prediction

Data collection systems from science missions collect vital information:

- Ocean buoys, rain and river gauges and other sensors to provide important information about ocean wave heights, wind activity and flood warnings

Data collection systems not only impact everybody's safety, but it also has impact on a country's economic health, for example:

- Economy: An extreme drought predicted based on soil moisture measurements can be devastating to crops, but with some advanced warning, mitigation measures can be planned
- Safety of Life: Ocean sensors, coupled with other data from satellites and aircraft, can provide early warning of potential hurricane activity

Key Space and Science Service Allocations

Space Operation Service (SOS):

A radiocommunication service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry and space telecommand (TT&C). (RR No. 1.23)

Satellite antenna used for tracking in Space Operations service

Space Research Service (SRS):

A radiocommunication service in which spacecraft or other objects in space are used for scientific or technological research purposes. (RR No. 1.55)

Space Research Service Antennas at Goldstone

Meteorological-Satellite (MetSat) Service:

An Earth exploration-satellite service for meteorological purposes. (RR No. 1.52)

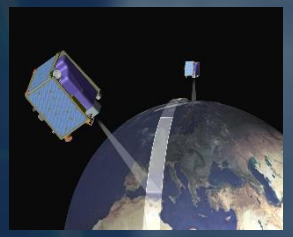
Advance polar –orbiting meteorological weather satellite

Earth Exploration-Satellite Service (EESS):

A radiocommunication service between Earth stations and one or more space stations, which may include links between space stations, in which:

- Information relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment, is obtained from active sensors or passive sensors on Earth satellites;
- Similar information is collected from airborne or Earth-based platforms;
- Such information may be distributed to earth stations within the system concerned;
- Platform interrogation may be included.

This service may also include feeder links necessary for its operation. (RR No. 1.51)



Single satellite sensing the Earth

Science Services in the World Radio Conferences and International Telecommunication Union (ITU)

- Next World Radiocommunication Conference (WRC-19) is November 2019
  - ITU member states participate in treaty-based modifications to the ITU Radio Regulations
- Technical preparatory work for the Conference is done in the ITU Radiocommunication Sector by Study Groups (SG) and Working Parties (WP)
  - Study Group 7 and its WPs (7A, 7B, 7C and 7D) deal with science services

- Agenda Items (AI) were decided at the last Conference to address regulatory issues identified as important for new and enhanced services requiring spectrum
- A Conference Preparatory Meeting (CPM) report will be developed containing approaches for satisfying each agenda item
- NASA is an active participant in U.S. Delegations (overseen by the U.S. State Department) to ITU and CITEL

Science Services Need Support at Upcoming WRCs

WRC-19 Agenda Items related to the Science Services

- AI 1.2 – Power limits for mobile-satellite service meteorological-satellite service/Earth Exploration-Satellite Service earth stations around 400 MHz
- AI 1.3 – Meteorological satellite service upgrade, addition of Earth Exploration-Satellite service allocation (space-to-Earth) at 460-470 MHz
- AI 1.7 – Space operation service spectrum for short duration non-GSO missions

Preliminary WRC-23 Agenda Items related to the Science Services

- AI 2.2 – Earth Exploration-Satellite Service (active) in the range 40-50 MHz
- AI 2.3 – Space weather (sensors)

Agenda Item 1.2
Establish Power Limits for 400 MHz MSS/MetSat/EESS Earth Stations

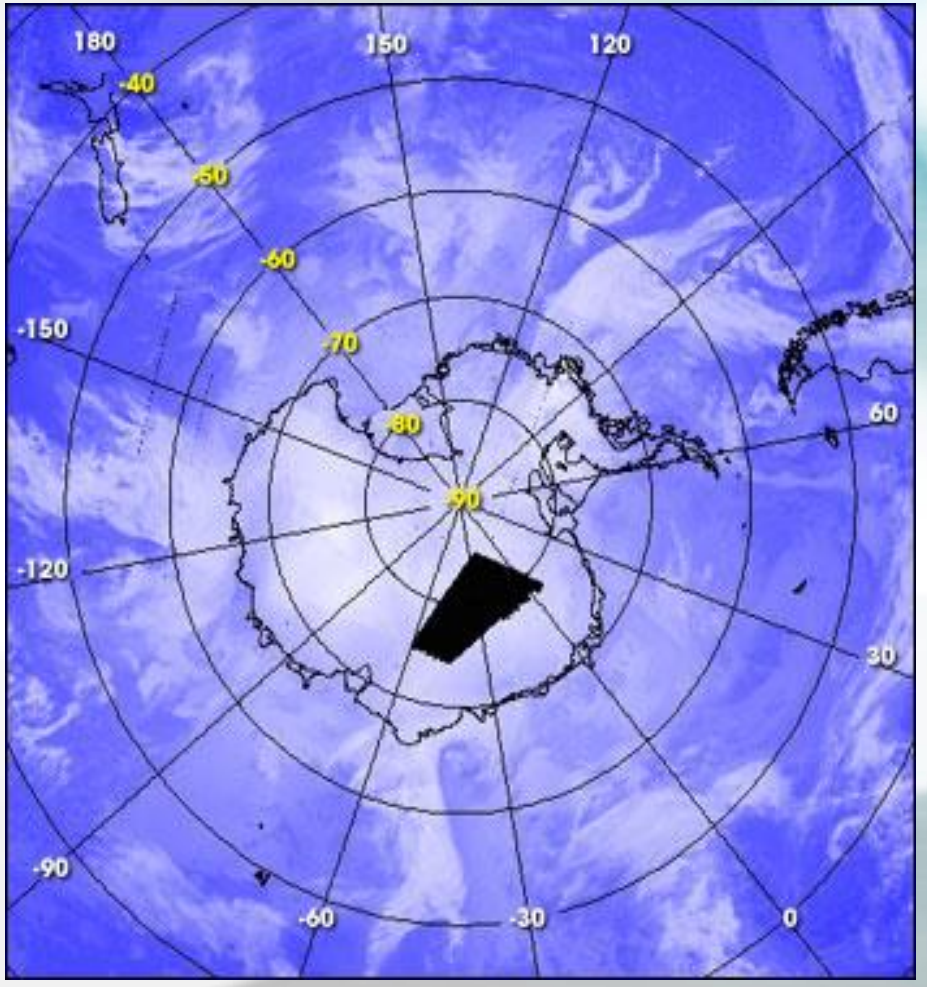
Bands around 400 MHz are allocated to EESS and MetSat service (Earth-space), as well as to the mobile satellite service (Earth-space)

- These frequencies have traditionally been used for Data Collection Systems (DCS), such as weather stations, ocean buoys, and atmospheric monitors that provide important information about weather, ocean currents, ocean temperatures and other data
- Transmitters are typically at low or medium power levels

New satellite operators want to use frequencies in this range for satellite Telemetry, Tracking and Control (TT&C) with:

- Much higher power levels
- Large constellations of satellites

Agenda Item 1.2
Establish Power Limits for 400 MHz MSS/MetSat/EESS Earth Stations

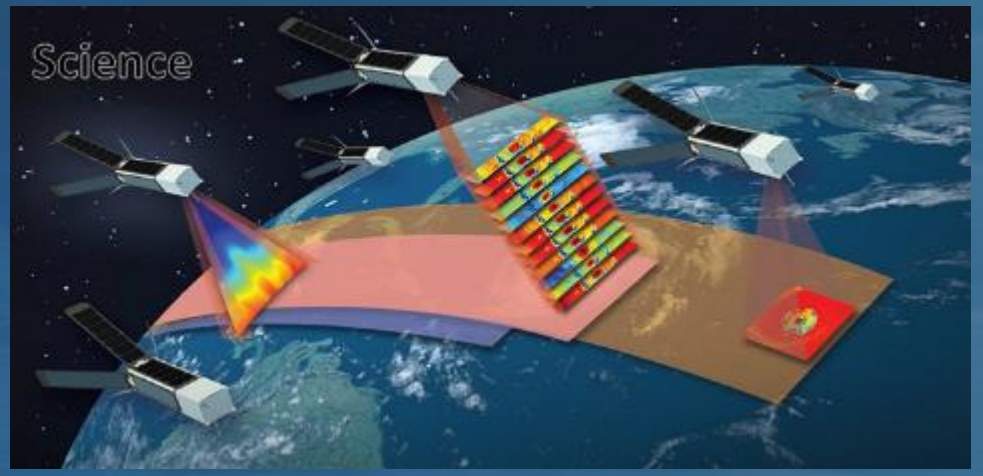


Current status:

- The draft Conference Preparatory Meeting (CPM) text to WRC-19 identifies alternative ways to allow sharing among the services by placing power restrictions on some systems
- A report with a complete set of technical characteristics will be finalized at an upcoming ITU-R Working Party (WP) 7B meeting
- A number of CITEL countries support ensuring that DCS systems can continue to operate without interference from other systems that would affect control or data

Agenda Item 1.3
Upgrade MetSat and Add EESS Allocation (space-to-Earth) at 460-470 MHz

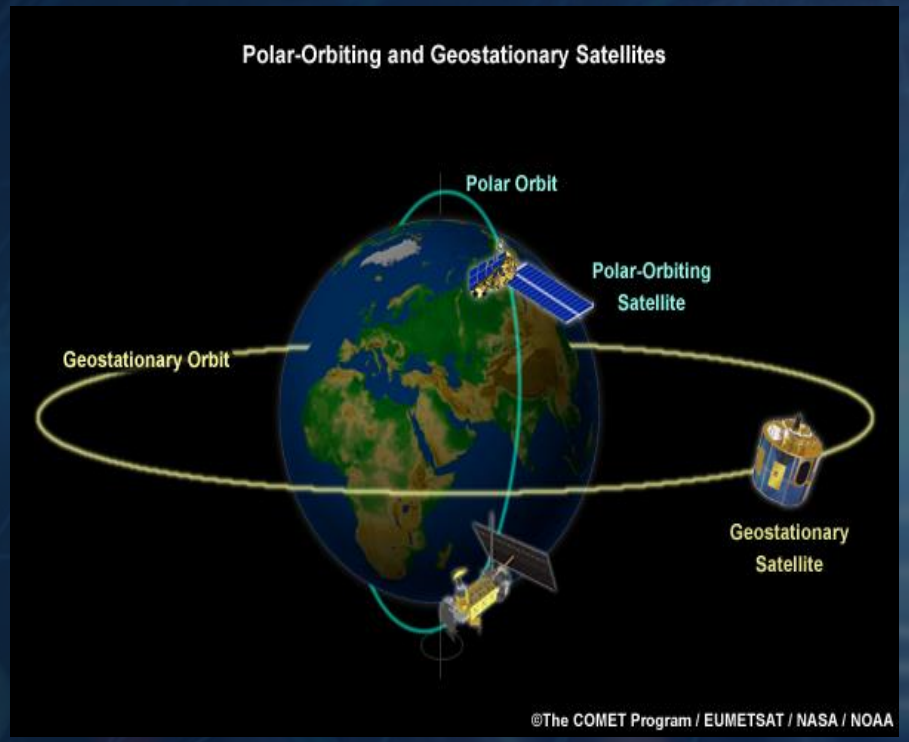
- The band 460-470 MHz is currently used for DCS (space-Earth) under an allocation for MetSat on a secondary-basis
- Some countries already provide MetSat a primary allocation, protecting them from interference from other services



- Today EESS may use the band on a sub-secondary level, and many small satellites have an EESS function
  - This Agenda Item seeks to add EESS as a primary allocation
- The band 450-470 MHz is also identified for International Mobile Telecommunications (IMT), and Administrations are adopting power level limits for their protection

Agenda Item 1.3

Upgrade MetSat and Add EESS allocation (space-to-Earth) at 460-470 MHz

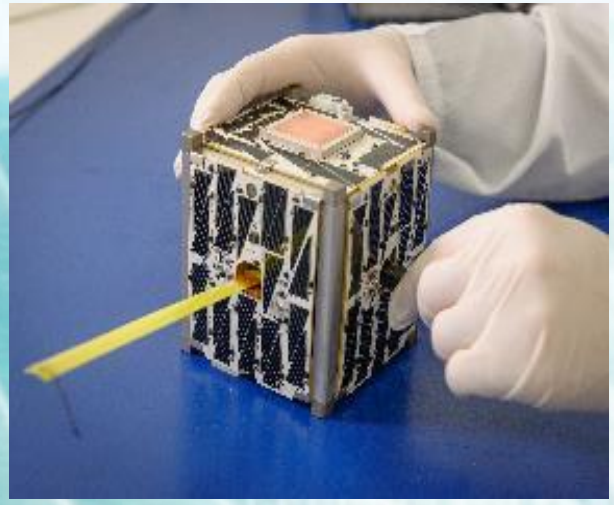


Current Status:

- Technical studies developed power limits for non-Geostationary Orbit (NGSO) satellites
- The draft CPM text to the WRC-19 indicates that upgrading to a primary allocation is feasible if the proposed limits are adopted
  - Note: power limits on Geostationary Orbit (GSO) satellites are still to be developed
- A report providing a complete set of technical characteristics is nearly complete and will be finalized during the Fall 2018 meeting of ITU-R WP 7B

Agenda Item 1.7
Improve Situation for Satellites with Short Missions

- Small satellites (typically having short duration missions) are increasing
- First time satellite operators tend to not fully understand their spectrum use requirements and responsibilities
- Radio Regulations do not differentiate between big vs. small satellites or short vs. long duration missions
- Small satellites have very short development, deployment and mission lifecycles in comparison to the timeline for submitting and processing satellite network filings



This Agenda Item calls for review of spectrum requirements in the space operations service (SOS) for allocations in spectrum below 1 GHz for Tracking, Telemetry and Control (TT&C)

Agenda Item 1.7
Improve Situation for Satellites with Short Missions

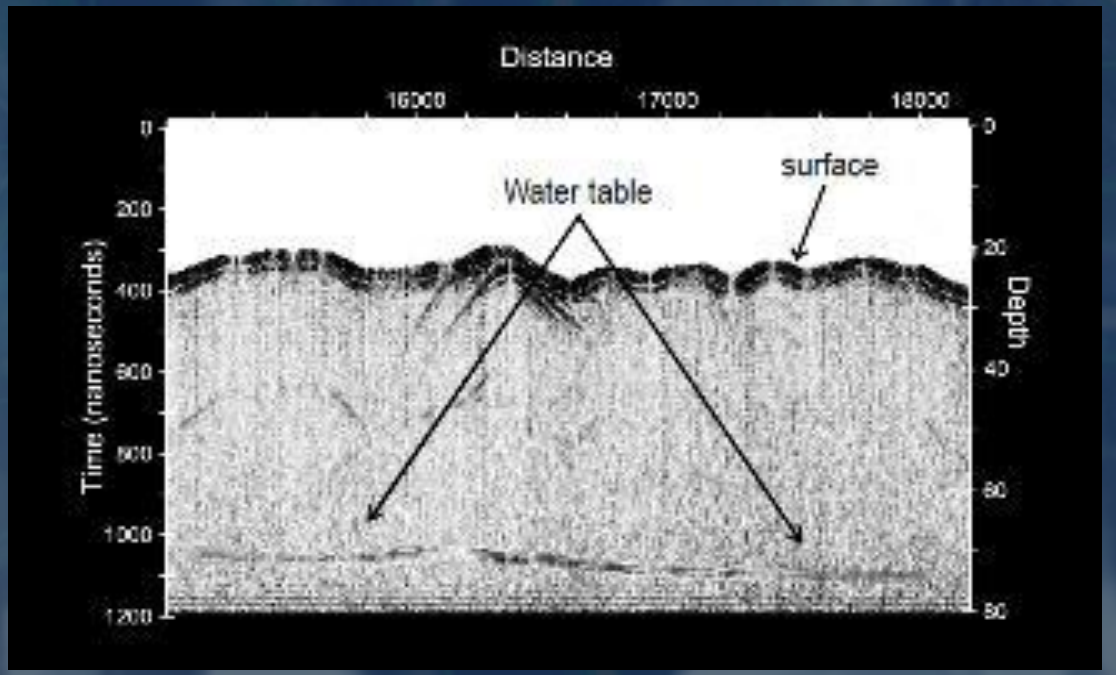
Current Status:

- The ITU-R has issued a characteristics report and a spectrum requirements report for satellites with short duration missions
- Many frequency bands were examined for sharing and a report is planned to be finalized during the Fall 2018 meeting of ITU-R WP 7B
- Besides No Change (NOC), the WRC-19 draft CPM text proposes different ways of addressing the issues, including making allocations at 137/138 MHz (space-Earth) paired with 148-149.9 MHz (Earth-space), and either 403-404 or 404-405 MHz for Earth-to-space NGSO system

WRC-23: Preliminary Agenda Item 2.2
Earth Observation Around 40-50 MHz

A new allocation in the 40-50 MHz band is needed for making space-based subterranean radar observations in the polar and Sahara desert regions

- Detection of subsurface desert water tables
- Identification of volume characteristics and depths of polar region ice sheets



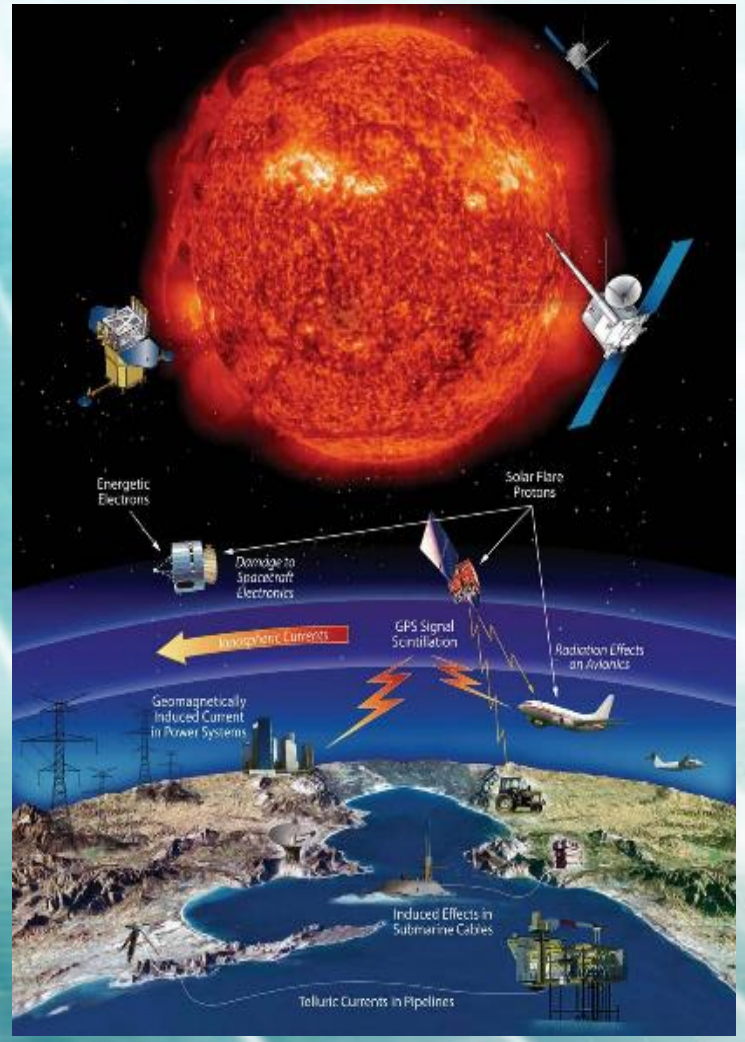
Current Status:

- NASA, via the U.S., is conducting studies in ITU-R to evaluate sharing with incumbent terrestrial services
- Preliminary studies indicate how sharing can be feasible

WRC-23: Preliminary Agenda Item 2.3
Protection Against Space Weather

Sensors used for monitoring “Space Weather” (aka “solar weather”) need access to spectrum for both sensing of physical phenomena in space (e.g. solar flares), transfer of that sensor data to Earth for analysis, and for control and tracking of those satellite sensors

- Operation and characteristics of these sensors are not well understood within the spectrum community
- Understanding how the sensors operate, and their characteristics, are important for sharing and compatibility studies



Current Status:

- NASA and NOAA are gathering detailed information within the U.S. on sensor characteristics and operation in order to facilitate accurate sharing and compatibility studies with respect to spectrum use in the future

Thank You!

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